53. (New) The method of claim 43, wherein step (e) is effected by at least one sensor positioned on said second unharvested plant.

54. (New) The method of claim 42, wherein step (c) is effected by processing unit.

a8 cncl.

55. (New) A method of assessing the state of a greenhouse grown crop comprising:

(a) co-cultivating a first plant with a crop of a second plant, said first plant being more sensitive to a change in at least one environmental factor or an infection by a pathogen than said second plant; and

(b) monitoring at least one plant derived parameter associated with said first plant to thereby assess the state of the greenhouse grown crop.

REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1- 28 are in this case. Claims 1-28 have been rejected. Claims 1-6, 12, 13, 15-17, 19-23, 25, 26 and 28 have now been amended. Claim 8 has now been cancelled. New claims 29-55 have now been added.

35 U.S.C. § 102(b) Rejections – Carlson et al (US 4,569,150)

The Examiner has rejected claims 1-4 and 6-28 under 35 USC § 102(b) as being anticipated by Carlson et al. The Examiner's rejections are respectfully traversed. Claims 1-6, 12, 13, 15-17, 19-23, 25, 26 and 28 have now been amended. Claim 8 has been cancelled, rendering Examiner's rejection thereof moot.

The Examiner states that Carlson et al discloses "a method of assessing a state of a plant" comprising collecting plant related data over a predetermined time period, analyzing the data to identify a trend, correlating the trend to an environmental parameter, analyzing the trend and communicating with a user client to modify the state of the plant (using an irrigation device and a climate control device). The Examiner further states that Carlson et al teaches selecting a first and second plant, for comparison of data, co-cultivation of a group of plants and monitoring plant parameters to assess the state of a crop.

The present invention is of a method and system employing remote sensors of specific plant parameters which can be used to determine and correlate trends indicative of a state of a crop, in real-time, for precise and accurate crop management. Applicant is of the strong opinion that Carlson et al. does not teach nor provide motivation for the use of a system of identifying, evaluating and acting upon such trends during crop growth.

Carlson et al. teaches a method for "optimizing growth of plants in a greenhouse or other protected area" by providing control of atmospheric parameters (light, temperature, airflow and CO_2) in the greenhouse, and regulating temperature and CO_2 within the greenhouse as a function of experimentally determined equations (see column 2, lines 30-34). The Examiner states that Carlson et al discloses assessing a state of a plant by collecting data pertaining to at least one plant parameter over a predetermined time period. However, careful examination of the cited paragraphs reveals that the prior art teaches the conducting of complex and lengthy experimentation, with "sample" populations, under a great variety of environmental conditions, far prior to the actual crop growth, in order to allow elaboration of equations for improved growth. The method of Carlson et al necessitates harvesting the sample crop in order to perform the statistical analysis (col. 3, lines 54-68) with which the equations for the "model" are derived. Following the

harvesting the user, according to the prior art invention, must conduct a step of validation, i.e. additional experimentation "where plants are grown using the equations as a basis of control...to determine if they (the equations) accurately predict observed response"(col. 4, lines 25-37). Carlson et al explicitly states that one must repeat such cycles of crop growth, harvest, measurement and analysis until "accurate prediction of improved growth support the equation's validity. If the equations are inadequate, or if improved or expanded prediction are desired, one must repeat the ...(entire) process starting at I"(col. 4, lines 29-40).

Thus, the prior art describes a method of sampling and experimentation, which may be employed to derive functions ultimately applicable to control of environmental parameters in greenhouse crop cultivation. Indeed, the majority of the specification and claims describe, in great detail, the mathematical derivation of such functions from specific experiments. However, as disclosed, the method of Carlson et al cannot provide real-time monitoring of crop performance during a growth cycle, as disclosed in the present specification. Further, application of the method of Carlson et al is strictly limited to "plants grown in a greenhouse, or other protected area". Field-grown crops are thus expressly excluded.

In stark contrast, the present invention is of a phytomonitoring system and method providing real-time assessment of plant-derived parameters which can be used to accurately assess the state of the plant or crop without having to resort to prior experimentation or expert interpretation of data collected from the plant or environment.

Applicant is of the opinion that Carlson et al. does not, neither alone, nor in combination with the teachings of others, teach or provide motivation for the use of a system for assessment of an unharvested crop from plant derived data whether the crop is grown in a greenhouse or a field. To further distinguish the present invention from prior art, and to expedite prosecution in

this case, claim 1 has now been amended to recite:

"A method of assessing the state of a field grown crop comprising:

(a) collecting data pertaining to at least one plant derived parameter over a predetermined portion of the growth cycle of the crop, wherein said collecting is effected by at least one sensor positioned on a plant of the crop and whereas the crop is unharvested, and

(b) analyzing said data collected over said predetermined portion of the growth cycle to thereby identify a trend in said data over at least a portion of said growth cycle, said trend being indicative of the state of the crop."

Similarly, claim 10 has now been amended to recite:

"A system for assessing a state of a field grown crop comprising:

(a) at least one sensor positioned on an unharvested plant of the crop, said at least one sensor positioned on an unharvested plant, said sensor being for collecting data pertaining to at least one plant derived parameter; and

(b) a user client being in communication with said at least one sensor, said user client being for receiving and optionally analyzing said data collected from said at least one sensor over a predetermined portion of the growth cycle of the crop to thereby identify a trend in said data over at least a portion of said predetermined portion of the growth cycle of the crop, said trend being indicative of the state of the crop.",

and independent claims 15 and 28 have now been amended to include the

limitations "field grown crop", "unharvested plant", "plant derived parameter" and "predetermined portion of the growth cycle of the crop".

Thus, the method described in now amended independent claims 1, 10, 15 and 28 and claims directly and indirectly depending therefrom, explicitly assesses an *unharvested crop* in real-time, during it's growth cycle, using advanced sensing units "...*positioned on a plant* of the crop..." for the collection of data "...pertaining to at least one *plant derived* parameter..."(emphasis added) for the monitoring of a representative individual, or number of individual plants, in order to determine the "state of a field grown crop". Support for such amendments can be found throughout the instant specification. For example, Figures 1a-b show a schematic representation of system **10** for assessing the state of an unharvested crop, demonstrating the positioning of plant-mounted sensors (**12**) (see also page 17, line 13 to page 20, line 7), designed capable of providing plant derived data from growing, unharvested plants. Similarly, in the Examples section, the sensors described are "non-invasive sensors" (page 25, lines 13-15), specifically suited to provide real-time monitoring of growth trends from plants of growing crops without need for harvesting the data-providing plants.

This feature of the present invention is neither described or suggested by the prior art, which teaches equations and functions derived by repetitive experiments measuring a limited number of plant related parameters prior to the crop's growth, rather than during the growth cycle, for climate control within a greenhouse. The system and methods of the instant invention provide real-time, plant-derived data for precise and accurate management of a crop throughout it's growth cycle. The plant-derived data collected by these sensors is from the unharvested plant itself such as "...leaf temperature data, flower temperature data, fruit surface temperature data, stem flux relative rate data, stem diameter variation data, fruit growth rate data and leaf CO_2 exchange data"(page 15, lines 9-12, and claim 3).

Collecting and measuring plant derived data from an unharvested crop provides the system and methods of the present invention numerous advantages over the methods of experimentation and data analysis for regulating temperature and carbon dioxide in a greenhouse environment described in the prior art.

Thus, real-time, plant-derived parameters, measured during the growth cycle of the actual crop, such as "hydration and growth state", as measured by stem diameter variation, "water stress or ample watering", as measured by fruit diameter variation or transpiration state, as measured by sap flow (page 19, line 16 to page 20, line 2) which are monitored automatically, without user participation by the system of the present invention are neither collected nor monitored from the growing crop by prior art systems. Such parameters are crucial for accurate, real-time monitoring of short and long term trends of crop growth, health state, etc., as described in detail in the instant specification (see page 31, lines 1-13).

It is well known in the art that the growth and development of crop plants, such as fruit trees and flowering plants, requires many component stages, the timing and pace of which depend on the state of the plant with regard to changing environmental conditions. The method of Carlson et al., and other currently available greenhouse management systems which depend on statistical crop performance data accumulated from experimentation and past experience, are inherently unsuited for non-invasive, real-time assessment of crops having lengthy and complex cycles of cultivation. Whereas experimentally-derived data such as that provided by the method of Carlson et al may be applied in a predetermined manner over the crop's cultivation cycle in response to perceived changes in environmental conditions, the present invention facilitates real-time monitoring of the state of the growing crop, relying on plant-derived trends, rather than previously accumulated data, for precise and accurate crop management.

As taught in the instant application, a state of an unharvested crop can be determined by data processing from the plant mounted sensors or by simply comparing sensor data collected over a portion of the growth cycle of the crop, and identifying "plant-related trends" (page 15, lines 3-12). Furthermore, accumulation and processing of data collected by the plant mounted sensors of the present invention can provide unique long term crop characteristics previously unavailable to growers, such as daily integration of solar radiation, reference evapotranspiration, etc., as well as duration and magnitude of measurable stress conditions, without need to resort to undue experimentation. By carefully selecting individual plants as crop standards (page 17, line 4 to page 18, line 18), and by providing remote and/or automated processing, transmission and storage of the data collected by the remote plant mounted sensors, the system and method of the instant invention enable a remote operator and/or data processing system to track and monitor the state of the crop without having to resort to an expert interpretation of data collected. Thus, the present invention provides a grower with the tools to monitor a crop state in real time, and respond to changes in plant growth parameters during the cultivation cycle with superior precision and speed, achieving improved crop yield, quality and resource (water, energy, etc.) conservation with reduced investment.

In stark contrast, Carlson et al. discloses: "...a method for optimizing the growth of plants in a greenhouse... wherein the regulation and venting is controlled...using an equation arrived at from experimental growth data"(column 10, lines 37-38). Carlson et al does not describe, nor suggest systems or methods suitable for remote and precision monitoring of individual plants, or numbers of plants, by plant mounted sensors of plant derived parameters, and processing of the data obtained thereby for determining the state of a crop, as provided by the system and method of the instant invention.

Applicant is of the strong opinion that, considering the objective

evidence detailed hereinabove, the system and methods for assessing the state of a field grown growing crop as described in the instant invention are clearly distinguished from the experimentally derived and validated equations for temperature and carbon dioxide control in the greenhouse structure taught by Carlson et al in both scope and content.

As such, it is Applicant's strong opinion that Carlson et al. do not anticipate nor render obvious the present invention as claimed.

35 U.S.C. § 103(a) Rejections – Carlson et al, in view of Huguet et al.

The Examiner has rejected claim 5 under 35 USC § 103(a) as being unpatentable over Carlson et al in view of Huguet et al. The Examiner's rejections are respectfully traversed. Claims 1-6 have now been amended.

The present invention is of a phytomonitoring system and method providing real-time assessment of <u>plant-derived parameters</u> which can be used to accurately assess <u>the state of the plant or crop</u> without having to resort to prior experimentation or expert interpretation of data collected from the plant or environment.

Applicant is of the opinion that Carlson et al. does not, neither alone, nor in combination with the teachings of Huguet et al, teach or provide motivation for the use of a system for <u>assessment of an unharvested crop from plant derived data whether the crop is grown in a greenhouse or a field</u>. To further distinguish the present invention from prior art, and to expedite prosecution in this case, claim 1, from which claim 5 derives direct antecedent basis, has now been amended to recite:

"A method of assessing the state of a field grown crop comprising:

(a) collecting data pertaining to at least one plant derived parameter over a predetermined portion of the growth cycle of the growing crop, wherein said collecting is effected by at least one sensor positioned on a plant of the crop and whereas said growing crop

is unharvested, and

(b) analyzing said data collected over said predetermined portion of the growth cycle to thereby identify a trend in said data over at least a portion of said growth cycle, said trend being indicative of the state of the crop."

Applicant is further of the opinion that one of ordinary skill in the art would not be motivated to combine the teachings of Carlson et al with the method of graphically representing the data obtained on a graph as taught by Huguet et al.

Notwithstanding from the above, even in the event that the teachings of Carlson et al and Huguet et al. are co-integrated by one of ordinary skill in the art into a system capable of graphically representing data collected from plants for analyzing in order to exhibit relationship between the data points, such a system would not anticipate or render obvious the systems and methods for real-time phytomonitoring and precision assessment of a growing crop disclosed in the instant application.

In view of the above amendments and remarks it is respectfully submitted that independent claims 1, 10, 15 and 28, and claims 2-7, 9-14 and 16-27, which directly or indirectly depend therefrom as well as new claims 29-55 are now in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully
submitted,

Sol Sheinbein
Attorney for Applicant
RegistrationNo. 25,457

Date: December 26, 2002.

Encl.
Version with marking to show changes made;
Three month's extension fee; and
Tranmittal fee for additional claims.

VERSION WITH MARKING TO SHOW CHANGES MADE

OIPE JC139
DEC 30 2002
PATENT & TRADEMARK OFFICE

In the Claims:

1. (Amended) A method of assessing a state of a field grown crop~~plant~~ comprising:

(a) collecting data pertaining to at least one plant derived~~related~~ parameter over a predetermined portion of the growth cycle of the crop, wherein said collecting is effected by at least one sensor positioned on a plant of the crop and whereas the crop is unharvested~~time period~~; and

(b) analyzing said data collected over said predetermined portion of the growth cycle ~~time period~~ to thereby identify a trend in said data over at least a portion of said ~~predetermined time period~~growth cycle, said trend being indicative of the state of the crop~~plant~~.

2. (Amended) The method of claim 1, further comprising the step of correlating said trend to an additional trend derived from data pertaining to an additional plant derived~~related~~ parameter collected over said predetermined portion of the growth cycle of the crop.~~time period.~~

3. (Amended) The method of claim 1, further comprising the step of correlating said trend to at least one environmental parameter data acquired prior to or during said predetermined ~~time period~~ portion of the growth cycle of the crop to thereby determine said state of the field grown crop~~said plant~~.

4. (Amended) The method of claim 1, wherein said trend represents a positive change in a value of said at least one plant derived~~related~~ parameter, a negative change in said value of said at least one plant derived~~related~~

parameter, or no change in said value of said at least one plant derived~~related~~ parameter over said at least a portion of said predetermined portion of the growth cycle of the crop ~~time period~~.

5. (Amended) The method of claim 1, further comprising the step of graphically representing said data pertaining to said at least one plant derived ~~related~~ parameter over said predetermined portion of the growth cycle of the crop ~~time period~~.

6. (Amended) The method of claim 1, wherein said data pertaining to said at least one plant derived ~~related~~ parameter is selected from the group consisting of leaf temperature data, flower temperature data, fruit surface temperature data, stem flux relative rate data, stem diameter variation data, fruit growth rate data, leaf CO2 exchange data and stem elongation rate data.

10. (Amended) A system for assessing a state of a field grown crop~~plant~~ comprising:

(a) at least one sensor positioned on~~, or in proximity to, the~~an unharvested plant, said at least one sensor being for collecting data pertaining to at least one plant derived ~~related~~ parameter; and

(b) a user client being in communication with said at least one sensor, said user client being for receiving and optionally analyzing said data collected from said at least one sensor over a predetermined time period to thereby identify a trend in said data over at least a portion of said predetermined portion of the

growth cycle of the crop ~~time period~~, said trend being indicative of the state of the crop~~said plant~~.

12. (Amended) The system of claim 10, further comprising a display being for displaying said data collected from said at least one sensor over said predetermined portion of the growth cycle of the crop~~time period~~.

13. (Amended) The system of claim 10, further comprising at least one device being in communication with said at least one user client, said device being for modifying said state of the field grown crop~~said plant~~.

15. (Amended) A method of assessing a state of a field grown crop comprising:

(a) selecting a first unharvested plant, said first plant being representative of the crop;

(b) collecting a first set of data pertaining to at least one plant derived ~~related~~ parameter of said first unharvested plant over a predetermined portion of the growth cycle of the crop ~~time period~~; and

(c) analyzing said first set of data collected over said predetermined ~~time period~~ portion of the growth cycle of the crop to thereby identify a trend in said first set of data over at least a portion of said predetermined portion of the growth cycle of the crop ~~time period~~, said trend being indicative of a state of said first unharvested plant and thus the state of the field grown crop.

16. (Amended) The method of claim 15, further comprising:

(d) selecting a second unharvested plant, said second plant being a reference plant to said first unharvested plant;

(e) collecting a second set of data pertaining to at least one plant derived ~~related~~ parameter of said second unharvested plant over said predetermined portion of the growth cycle of the crop ~~time period~~; and

(f) comparing said first set of data and said second set of data to thereby verify that said first unharvested plant is representative of said field grown crop.

17. (Amended) The method of claim 15, wherein said step of selecting said first unharvested plant is effected according to at least one selection criterion.

19. (Amended) The method of claim 16, wherein said step of selecting said second unharvested plant is effected according to said at least one selection criterion.

20. (Amended) The method of claim 15, further comprising the step of correlating said trend to an additional trend derived from data pertaining to an additional plant derived ~~related~~ parameter collected over said predetermined portion of the growth cycle of the crop ~~time period~~.

21. (Amended) The method of claim 15, further comprising the step of correlating said trend to at least one environmental parameter data acquired prior to or during said predetermined portion of the growth cycle of the crop ~~time period~~, to thereby determine the state of said first unharvested plant and thus the state of said field grown crop.

22. (Amended) The method of claim 15, wherein said trend represents a positive change in a value of said at least one plant derived ~~related~~ parameter, a negative change in said value of said at least one plant derived ~~related~~ parameter, or no change in said value of said at least one plant derived~~related~~ parameter over said at least a portion of said predetermined portion of the growth cycle of the crop ~~time period~~.

23. (Amended) The method of claim 15, wherein said data pertaining to said at least one plant derived~~related~~ parameter is selected from the group consisting of leaf temperature data, flower temperature data, fruit surface temperature data, stem flux relative rate data, stem diameter variation data, fruit growth rate data, leaf CO2 exchange data and stem elongation rate data.

25. (Amended) The method of claim 15, wherein said step of collecting said first set of data is effected by at least one sensor positioned on~~, or in proximity to,~~ said first unharvested plant.

26. (Amended) The method of claim 16, wherein step (e) is effected by at least one sensor positioned on~~, or in proximity to,~~ said second unharvested plant.

28. (Amended) A method of assessing the state of a field grown crop comprising:

(a) co-cultivating a first plant with a crop of a second plant, said first plant being more sensitive to a change in at least one

environmental factor or an infection by a pathogen than said second plant; and

(b) monitoring at least one plant derived parameter associated with said first plant to thereby assess the state of said crop.